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of the total resistance due the load. As the result of some experiments, "it is found that the friction of the high-speed non-condensing engine, such as is used in electric lighting, is, under standard conditions, practically constant at all loads, but is variable both with speed of engine, and with steam pressure."

Dr. Thurston exhibited a photograph, and described the great dynamo recently designed by Mr. C. F. Brush, for the Cowles electrical smelting and aluminium company of Cleveland, Ohio, and Lockport, N. Y.

Two papers were read on civil engineering subjects, one with reference to the improvement of harbor and river channels, by Prof. Lewis M. Haupt, and the other upon the difficulties met with in the Panama canal, and the rights which France will be disposed to assume in that connection.

Professor Haupt maintained that all structures of any considerable magnitude and weight, intended to regulate currents, and which rested on, or depended upon, sandy or alluvial bottoms for their support, violated to a greater or less extent the fundamental requirements that they should not oppose the ingress of the tide, nor injuriously modify the currents; also that dikes or jetties were to a great extent below the zero plane or plane of action of waves of translation, and were dependent for their strength upon their mass, and that this was frequently composed of individual fragments of small dimensions, not cemented. It was stated that all such constructions occupy a large volume, produce great pressure and leverage, are wasteful of time and materials, result in serious modification in the regimen of rivers or harbors, are unnecessarily expensive, and if improperly located, they cannot be readily changed. In contrast with this, the professor then suggested a solution, consisting of a floating system of deflectors intended to be attached to buoys or floats, and anchored to heavy moorings, composed of ground chains, held in place by screw discs sunk considerably below the bottom, and proceeded to describe his system.

As a set-off to the papers of more certain value, and perhaps for purposes of recreation, the section listened to a paper detailing observations and experiments, mixed up with some remarkable theories upon the flight of birds, and the serious business of the meeting being over, a last session was devoted to a continuance of the discussion thereon. A letter to the following effect received from a member explains to some extent this action of the section: "In order that this investigation may not be dropped, you may announce that if the gentleman will successfully reproduce before the section the experiments for which he vouches, i.e., if his apparatus, without moving mechanism

or outside assistance, supports itself in still air, and moves against a current of air without falling, I will give fifty dollars as a prize for the best paper on the subject, at the next meeting."

An extract from the abstract furnished will also explain to a sufficient extent, for any one acquainted with the laws of mechanics, the supposed peculiar action of gravity in favor of soaring birds. According to the abstract, 'explanations of soaring flight' have been failures, and the 'gravity of the bird's mass' must be resolved 'by the plane of the wings under the law of fluid pressures, and Newton's third law of motion,' in consequence of which 'artificial birds or effigies' 'will imitate the soaring birds,' and 'move against the wind indefinitely!' The abstract concludes with something like a new law in mechanics: "The gravitating force is a continuous motive power when forcing a properly constructed plane to work on air in a certain definite manner, of which the soaring birds are examples." We have often brooded, in that part of our imagination devoted to the figures of mathematics and plus and minus quantities, over the pleasure it would afford to physicists, and ordinary people, could some way be found of changing at will the algebraic sign of gravity or producing negative mass, so that a body might fall upward, but we were scarcely prepared to hear that it could be accomplished by so simple a device as a bird's wing, rough in one direction and smooth in the other,—but the section no doubt needed recreation.

PROCEEDINGS OF THE SECTION OF ECONOMIC SCIENCE AND STATISTICS.

THE programme of this section was popular and varied, as usual, for, besides contributions strictly statistical and bearing upon social and political economics, it is customary to refer to the section all papers which are philosophic rather than technically scientific, or which, although based upon sound science, are in an especially popular form. The casual visitor, after being wearied, puzzled, and confounded in the rooms of the other sections, usually finds in this one something interesting and instructive, and its audiences are largely local in character. The Buffalo sessions have been no exception to the rule. The meetings of this section have been well attended, and while the standard of the papers read has been hardly equal to that of last year, when Mr. Atkinson so well led the way, the average has been good, and the section has been comparatively free from the attacks of socialistic and economic cranks, to which it is especially subject.

Following appropriately the address of Vice-

President Cummings, a paper on 'A more humane and novel mode of criminal correction' was read by John Müller, of Ann Arbor, Mich. The audience was in full sympathy with the criticisms of our penal institutions, and the appeal for a more rational and humane treatment of the younger and hopeful classes of criminals, with a view to their safe restoration; but when emasculation of the intractables was boldly advocated, and argued by reference to the successful subjugation of brute beasts through castration, no encouraging response met the reader. He well described his own paper as 'a popular subject treated in a very unpopular manner.'

Mr. Müller was more fortunate in his treatment of the question, 'How can spelling reform become a success?' Upon the premise that in rational spelling there should be one sign for one sound and but one sound for one sign, he presented an alphabet of twenty-seven characters, which he claimed sufficient for English wants, and quoted eminent teachers to prove that one-third of the time of the pupil can be saved by use of the phonetic spelling, and that children can be taught to read ordinary compositions in five months. Characters proposed by different persons were shown upon the blackboard, and a lively discussion ensued. A serious difficulty arises in the failure of these reformers to agree upon a system, as unanimous consent is manifestly essential to the successful introduction of such a change. In the discussion it was notable that nearly all the critics of English spelling were foreigners.

'Centenarianism in the United States,' was a masterly analysis, by Joseph Jastrow, of Germantown, Penn., of the statistics on the subject named. In the tenth census, the number of persons aged a hundred years or over is given as 4,016, which was declared absurd, especially as more than three-fourths of these are colored people and more than half of all are colored females. The chief cause of these gross errors is exaggeration, both from ignorance and intent. This exaggeration has been steadily decreasing for a half century, the decennial tables showing a uniform decline, with the exception of 1870, when the freed negroes interrupted the downward scale. There being evidences that the errors accompany illiteracy, the best means of correction is to assume as probably most accurate the ratio of centenarians to the whole population, among the natives in the states of least illiteracy. Combined with this, the author used what he termed the 'decimal exaggeration,' or the excess of the number at a 'round' age, as given by the census, viz., at twenty, thirty, etc., over the number at the next year below, — an excess which the doctrine

of 'expectation of life' shows to be impossible. Under this method of correction, one-third of the states with least tendency to error being used as the basis, the number of centenarians is reduced to about one hundred and fifty. Up to this point, the native male whites have been regarded as perfectly reliable. This is evidently not the case, and the estimate is hazarded that inasmuch as only one in twenty-five of the alleged cases in the whole country has proved genuine, *two in three* of the remainder may be doubted, as unintentional errors, leaving but fifty centenarians in the United States, or about one to every million of population. The figures of the census are thus reduced by dividing by eighty, — and this great alteration is sustained by similar researches in England.

'The social waste of a great city' was the title of a long and verbose paper read by Dr. L. L. Seaman, of New York city. The author's experience in ten years' medical service in the city hospitals and charitable institutions led him to vigorously denounce the system of control by city politics, the association of charity with correction in the administrative boards, — claiming that it was erroneous and mischievous to assume a close relation between poverty and crime, — and 'the monopolizing and poisoning' of over six hundred acres of the fine island areas on the front of the city by their present uses. The chief service of this paper was in bringing out a severe criticism by Mr. Edward Atkinson, who took a far more hopeful view of the tendency of the times towards improving the condition of the poor and the lessening of crime in our large cities.

E. B. Elliott, actuary of the treasury department at Washington, presented two papers, mainly tabular and statistical. The titles were: 'Formulas for determining the United States gold value of silver bullion, when the London price per ounce of standard silver and the price of sterling exchange between New York and London are known,' and 'Tables showing for a series of years the rates of interest realized to investors in the securities of the United States government.' The interest tables well illustrate the varying credit of the government, from before the war, to the darkest days of 1864, when lack of confidence and 'fiat money' made the earning-power of the gold dollar 16 $\frac{1}{2}$ cents per annum, and then through the period of sounder finance and restored confidence to the present time, when 'governments' yield the holder about 2 $\frac{1}{4}$ per cent. Mr. Elliott's algebraic formulae for silver values are of limited interest, but may be valuable at times. For a constant numerator, he multiplies the number of grains of fine silver in question (S) by the London price per ounce of standard silver in pence (d),

and this product by the price of sterling exchange, in United States money (E), or $S \times d \times E$, and uses the computed denominator 106.560. The value of a legal-tender dollar and of other silver coins is obtained by other denominators given, — thus, for the dollar, $\frac{dxE}{287.372}$. On the 6th of August, with silver worth 42d. per ounce in London, our silver dollar was worth in gold bullion 71.21 cents, our trade dollar (full weight), 75.505 cents, and our subsidiary coin, 68.7 cents to the dollar.

'Recent results in the sorghum sugar industry' was the title of a paper by Dr. Peter Collier, of Washington. Numerous comparisons were made between tests of sugar-cane and sorghum, favorable to the latter as a sugar-producing plant. As an illustration, 72 approved varieties of sugar-cane grown upon Governor Warmouth's plantation in Louisiana being examined, averaged 185 pounds of available sugar to the ton of cane. Similar examinations of sorghums by Dr. Collier and Professor Wiley, at the U. S. department of agriculture, including over one hundred varieties, showed the available sugar, per ton of cane, ranging from 177 to 199 pounds. The sorghum also, on the average, produced a lower per cent of glucose and of rejected solids than the sugar-cane, this being also in its favor. As a rule, sorghum yields a less product per acre than cane, but the cost of cultivation per acre is enough less to more than compensate. The great cost of an acre of cane is well known, while sorghum costs not over ten per cent more than a crop of Indian corn of the same area. Chemical results and the manufacture of sorghum sugar, both on an experimental scale and commercially, in Kansas and New Jersey, are such, to date, as to offer every encouragement to this industry. Dr. Collier thinks the record justifies his prediction of the production of sorghum sugar in this country, in the near future, at a cost not exceeding one cent a pound. Dr. Collier also presented, in the form of graphical charts, with brief verbal explanations, 'Statistics relating to the dairy industry.' Compiled from official figures, these charts conclusively disprove the claim that agricultural land and labor, live stock and products, including butter, have suffered depreciation at all disproportioned to the recent general shrinkage in values, because of the introduction of oleomargarine and other butter substitutes and imitations. On the contrary, the number and value of milch cows in this country, and of their pure products, are steadily increasing; and there is now more and better butter made and consumed in America than ever before, while its price, compared with most food products, has been strikingly well sustained.

'The theory of rent, and its practical bearings,' was discussed by Edward T. Peters of Washington, and with such communistic leanings as to meet little approval.

Mrs. John Lucas, of New Jersey, entered a paper upon silk culture, which was received and assigned a place on the programme, but the author failing to appear at the appointed time, the paper was read by title only.

PROCEEDINGS OF THE SECTION OF MATHEMATICS AND ASTRONOMY.

SO MANY important papers were presented in this section, that we cannot even mention them all. Professor Rogers presented two papers, one on the best form of chronograph, and the other, with Anna Winlock, on 'The limitations in the use of Taylor's theorem for the computation of the precessions of close polar stars.'

The next paper was by Professor Doolittle, of Lehigh university, upon a 'Change in the latitude of the Sayre observatory.' In 1877 Professor Doolittle made a zenith-telescope determination of the latitude of this observatory. Nine years later, he now brings forward a new determination of the same latitude, from the same pairs of stars (fifty-seven in number), with about the same number of observations, the two pieces of work being done with the same instrument, by the same observer, and as nearly as possible under exactly the same conditions. No two equally thorough and equally comparable pieces of work with the zenith-telescope have ever been offered as evidence for or against a change in latitude, and the result is interesting. The difference of the two latitudes comes out

$$\phi_1 - \phi_2 = +0^\circ.393 \pm 0^\circ.063,$$

when the probable error of the declinations is used in the weight-coefficients in each case. Or, since the results may be assumed practically free from the errors of declinations, the result is

$$\phi_1 - \phi_2 = +0^\circ.393 \pm 0^\circ.045.$$

In the remarks that followed, Professor Newcomb stated that to him it only meant that in one or both of these series of observations there was — as with every observer and every instrument — some source of small systematic error which 'no fellow could find out.' Mr. Woodward, of the geological survey, an expert with the zenith-telescope, and also in questions of probable error, stated that in the absence of further observations he should hesitate to say that the observations themselves really indicated a real change of latitude.

Dr. Gould read a very interesting historical account of the early attempts at astronomical photography, showing that it originated in this coun-